START

0012105

Hanford Waste Vitrification Plant
Westinghouse Hanford Company
P. O. Box 1970
Richland, Washington 99352

FLUOR DANIEL, INC.

Date: November 14,1990

Reference: Hanford Waste Vitrification Plant
DOE Contract DE-AC06-86RL10838
Fluor Contract 8457

Attention: Mr. Mike Gordon
State of Washington
Department of Ecology (PV-11)
Olympia, WA 98504-8711

Transmittal No.: WDOE-028

Gentlemen:

TRANSMITTAL

We enclose 5 copies of the items listed below. These are issued per US-DOE request.

Response due to Fluor: N/A
Responds to: CFF-224

Number	Rev.	Date	Title
B-595P-P140-17100	0	11/13/90	Section 17100 HWVP Distributed Control System

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D. Duncan, US EPA, Region X w/0

Very truly yours,

R. N. Gibbons
Project Director

RNG:

9112050015

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

Rev. B

SECTION 17100
HWVP DISTRIBUTED CONTROL SYSTEM

(B-595P-P140-17100)

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FOR INFORMATION ONLY

SECTION 17100
HWVP DISTRIBUTED CONTROL SYSTEM

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ATTACHMENTS

SECTION 17100
HWVP DISTRIBUTED CONTROL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

The work under this section includes but is not limited to the following:

A. The design, construction and testing of the Distributed Control System, complete, and in place.

B. Delivery of a system of hardware and software which permits the operators to start, supervise and stop the day to day operations of the plant.

C. Collection of process data for transfer to other computer systems within the Integrated Management and Control Systems (IMACS).

D. The equipment shall include: field interface termination cabinets, distributed processing computers, a data highway, fixed and portable operator consoles, printers, historical data recorders and DCS host computers.

E. Development of the DCS end of the communications links to local control panels and the MIS together with support for the integration and checkout of these communication links.

The performance of integration and checkout is incorporated in a separate specification (TBD in Detailed Design).

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ANS 10.4	1987 "American National Standard Guidelines for the Verification and Validation of Scientific and Engineering Computer Programs for the Nuclear Industry"
ANSI/ASME NQA-1	1987 "Quality Assurance Program Requirements for Nuclear Facilities"

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE 730	1984 "Standard for Software Quality Assurance Plans"
IEEE 828	1983 "Standard for Software Configuration Management Plans"
IEEE 983	1986 "Guide for Software Quality Assurance Planning"
IEEE 1012	1986 "Standard for Software Verification and Validation Plans"

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S5.1	1984 "Instrumentation Symbols and Definitions"
ISA S5.3	1982 "Graphic Symbols for Distributed Control/Shared Display Instrumentation. Logic and Control Systems"
ISA S5.5	1985 "Graphic Symbols for Process Displays"

NATIONAL FIRE PROTECTION CODE (NFPA)

NFPA 70	1990 National Electric Code

MILITARY SPECIFICATIONS (MIL)

MIL-217E	1986 "Reliability Prediction for Electronic Equipment"

DEPARTMENT of ENERGY

DOE/RW-0214	"Quality Assurance Requirements Document"

U.S. NUCLEAR REGULATION COMMISSION (NUREG)

NUREG 0856	1983 "Final Technical Position on Documentation of Computer Codes for High-Level Waste Management"

1.3 **RELATED REQUIREMENTS**

Specification Section 17500	Process Control Descriptions
Drawing No. H-2-121001	Block Diagram Distributed Control System

Drawing No. H-2-121003 Computer and Control Room Layouts.

Drawing No. H-2-XXXXXX Piping and Instrument Diagrams

1.3.1 Work Not Included

Excluded from the scope of this section are:

A. Process sensors.

B. Instruments and actuators.

C. Local control panels.

D. Hard-wired safety class controls.

E. Other computer systems within IMACs, which include the Analytical Laboratory Computer System (ALCS); the Health Protection Computer System (HPCS); and the Management Information System (MIS).

F. The UPS power supply.

G. Communications equipment external to the DCS, for example, the transmitters of intelligent instruments and the MIS end of the DCS to MIS data link.

H. Closed circuit television equipment.

1.4 **DEFINITIONS**

1.4.1 Abbreviations and Acronyms

AI	Analog Inputs
AO	Analog Outputs
ALCS	Analytical Laboratory Computer System
BCR	Backup Computer Room
BCCR	Backup Central Control Room
CR	Computer Room
CCR	Central Control Room
DCS	Distributed Control System
DI	Discrete Inputs
DO	Discrete Outputs
DOE	Department of Energy
DPU	Distributed Processing Unit
FOS	Field Operating Station (DCS equipment including the distributed processor units, termination cabinets and portable operating stations mounted in various dedicated locations throughout the plant)
HPCS	Health Protection Computer System
HWVP	Hanford Waste Vitrification Plant

I/O	Input/Output
IMACS	Integrated Management and Control System
ISA	Instrument Society of America
LAN	Local Area Network
MIS	Management Information System
MTBF	Mean Time Between Failure
PLAN	Plant Local Area Network

1.5 SYSTEM DESCRIPTION

The HWVP plant is to be built on the Hanford Reservation of the Department of Energy located near Richland, Washington. The purpose of the plant is to assist in the permanent disposal of high level radioactive waste. The waste is fed to the plant in the form of liquids and slurries; it is then concentrated and incorporated into a borosilicate glass and cast in stainless steel containers. These containers will be stored at the site until they are transported to a permanent geological repository.

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Data and Drawing Requirements (VDDR) form (Attachment A).

(To be determined)

1.7 SAFETY CLASSIFICATION

(To be determined)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation - 714 feet above sea level

B. Barometric Pressure - 14.3 PSIA

C. Outdoor Design Temperatures:

(1) Maximum Design Temperature - 101°F

(2) Minimum Design Temperature - 9°F

(3) Wet Bulb Design Temperature - 68°F

1.8.2 Plant Environment - Normal Operating Conditions

Name	Temperature	Relative Humidity
Central Control Room	72-74°F	35-55%

Computer Room	72-74°F	35-55%
FOS 1-3	72-76°F	Not Controlled
FOS 4-8	78-84°F	Not Controlled

1.8.3 Equipment Design Conditions - Ambient

Name	Temperature	Relative Humidity
Central Control Room	32-104°F	20-80%
Computer Room	32-104°F	20-80%
DPUs	32-122°F	Not Controlled

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

2.1.1 System Description

The Distributed Control System has four distinct functions. The primary function is to maintain day to day control of plant operations. The second is to act as a process data collector for itself and other computer systems. The third is to provide a training facility for plant operators and the fourth is to support the programming, testing and implementation of new and improved control strategies.

Because of the nature of the feed and product, the vendor shall demonstrate his design is dependable. To this end the proposed software and the data used in any reliability calculations, shall be based on similar systems and subsystems which have a documented history of service in more than one location.

2.1.2 Control Philosophy

The basic control philosophy of HWVP is to control the plant from the Central Control Room. DCS consoles will be used to supervise the operations of the control software which is resident in a number of Distributed Processing Units (DPUs) located throughout the plant. The DCS is supplemented by a number of local panels where the operators require visual or direct manual control. Whenever these local panels control part of the process, they are connected to the DCS for data collection or to implement logical permissives. A number of Field Operating Stations (FOS) located around the plant are used for marshalling field instrument wiring and interfacing to the Distributed Processing Units of the DCS. Portable terminals which can be plugged into any DPU in the FOS are used for local control during start up or maintenance of a process unit. Portable terminals are a part of the DCS.

Because of the nature of the HWVP product, stringent quality control procedures shall be observed including complete recording of the

process and plant operations during the handling of each canister and the characteristics of the contained product. In addition, HWVP uses relatively untried technology, therefore, the initial control strategy will be conservative. The DCS will collect data on a large number of process variables. Subsequent analysis of this data will lead to improved control strategies which can be implemented during the course of hot operations.

2.1.3 Controls and Logic

Application data will be supplied to the vendor as:

A. Application Data Bases containing instrument and actuator data, simple control and loop logic configuration data on magnetic media.

B. Complex logic, documented according to the standards identified in "CLD/SCD Format Final Report."

C. Graphics displays as drawings.

This data shall be used to configure the DCS and validate the custom software and operation of the DCS.

2.1.4 Operating Characteristics

When the DCS is fully operational, the DPUs execute all the computations necessary for process control, batch recipes, sequencing, interlocking, data acquisition and conversion, and communication.

Provisions are required for a process operator or maintenance technician to plug a portable terminal into the DPU. When access has been granted from the supervisory console in the control room, this terminal will have full control over the configuration and operation of that DPU.

Consoles which have been dedicated as an operator consoles, will be able to display data from any part of the plant but will be limited to a specific plant area for implementing operator commands. Reconfiguration of the software, apart from adjusting alarm limits and setpoints of certain loops will not be permitted.

The supervisory console will be permitted access to any of the DCS data and to accept all control inputs including reconfiguration of the software. The supervisory console will be the primary location from which control can be reassigned from the central control room to local panels or operators at DPUs.

Operator inputs whether from the consoles, local panels or DPUs, will require a key to be inserted and a password entered as well as the supervisors release before it is accepted.

2.1.5 Environment

The ranges of environmental conditions expected are stated in Paragraph 1.8.

The host computers and operator consoles will be housed in dedicated control rooms. They shall be constructed to accepted standards for data processing equipment. They will be air conditioned and have raised floors. DCS equipment shall be built for use in a normal commercial environment.

The distributed processing units will be housed, together with field termination cabinets in dedicated rooms located throughout HWVP. These rooms and their environment will not be designed to more exacting standards than normal plant locations.

There is no requirement for the DCS to be seismically qualified.

Every effort is made to shield all DCS equipment from radiation and no special hardening is required.

The DCS equipment shall meet electrical industrial standards. In particular:

All parts of the DCS will be supplied with 115V. 60Hz, single phase electric power from an uninterruptible power supply. This will provide a bumpless transfer to the backup power whenever the primary source fails.

The incidence of Electro-magnetic and Radio Interference is TBD in Detailed Design.

2.1.6 Architecture

A candidate architecture is illustrated in Drawing H-2-121001,the Block Diagram of the Distributed Control System. This drawing is intended to identify the DCS interfaces to the operators, the process, the training equipment, the software development equipment and the other systems in IMACS. It is not meant to indicate a preferred architecture for the DCS.

2.2 HARDWARE

2.2.1 General Description

The DCS shall consist of multiple dual redundant microcomputers communicating with each other over a redundant data highway. In

normal operation, one of each microcomputer pair acts either as the primary controller of a small part of the plant or as the basis for an operator interface console. The second acts as a hot spare for the primary microcomputer. The purpose of this design is to provide very high reliability and to localize the effect of a complete failure of any single subsystem by limiting the control span of the subsystem.

The control strategies and data collection tasks will vary through the life of the plant. The DCS shall be sufficiently flexible and with a minimum of 25% spare processing and storage capacity to accept improved algorithms and changes in scope with minimum disturbance to concurrent plant operations.

All parts of the DCS shall have built in test hardware and/or software to detect and alarm operational failures. Where dual redundant hardware is provided, the software shall monitor on- line and offline hardware and ensure that failover is essentially transparent to the process and provides a "bumpless" transfer of control.

The DCS and the data it contains shall be protected from inadvertent or malevolent actions. The supervisor may enable (or disable) a requirement for a key to be inserted or a password to be entered before the DCS will accept any input from the consoles or data from a communications line which would change the system configuration or data. Instructions which are generated at the training consoles or the programmers terminals will not be accepted by the on-line DCS system unless permission has been granted from the supervisors console.

There are eight major on-line elements of the DCS:

A. The "host" computers
B. Historical Data Recorders
C. Operator Interface Consoles
D. Distributed Processing Units
E. Portable Operator Terminals
F. Local Control Panel Interfaces
G. Dual Redundant Data Highway
H. Printers

In addition some of these elements may be configured to provide two off-line functions for the DCS:

(1) Software development
(2) Operator training

The manufacturer and characteristics of the DCS equipment shall be the vendor's normal standard.

To minimize the possibility of common mode failure, each of the host computers together with associated systems terminals and disk drives will be located in separate computer rooms in separate buildings.

Historical records maintained on the DCS are for use by the operator in the normal course of work. Record collection may be one of the functions performed by the host computers or on a separate dedicated unit attached to the data highway. Either design is acceptable.

Each operator console is to be equipped with a minimum of: two CRTs, one keyboard and one printer, in addition, space shall be provided in the console for mounting communications and closed circuit TV (CCTV) control equipment (both to be provided by others). Each CRT shall measure at least 19 inches on the diagonal and be capable of displaying alphanumeric and graphical information in color. The minimum graphical resolution required is 640x480 pixels with at least 16 different colors used on the same display.

Distributed Processing Units (DPUs) are located throughout the plant and are the primary control elements of the DCS. They are located at the Field Operating Stations (FOS) together with the field termination cabinets. The I/O capacity of each DPU shall be sufficient for a single DPU to provide effective and timely control for the largest single process unit in the plant and provide capacity for future expansion. It is assumed that the maximum capacity of a DPU is assumed to be 300 I/O points and to permit expansion in capacity, a maximum of 240 points will be installed at delivery including 25% installed spares. The design shall be such that the field wiring can be run to the termination cabinets, and checked out, prior to installation of the DPUs or DPU electronics. When the DPUs are installed, connection to the termination cabinets shall be made using pre-built multi- conductor ribbon cables.

In the event of an accident or earthquake, the plant may have to fail to or be placed in a safe condition. All final control actuators are designed to fail to a safe condition on loss of signal from the DCS. The DCS design shall separate the power supplies to the output cards from the power supply to the input cards. Provision for switching off (or restoring) the output card power supplies using a relay in each DPU which can be operated (deenergized) remotely from a control room is required.

The portable operator terminals are to be used for start up and local maintenance work. They shall be designed to plug into the DCS data highway or directly into a DPU. When granted permission by the supervisor, they can be used for the local control of one or more process units or of a DPU. They shall have a single CRT and keyboard. The design shall be as close as possible to the design of the standard operator console without jeopardizing portability.

Installed in each FOS are interfaces between the local control panels and the DCS data highways. The design shall be similar to the DPUs in that the field wiring to the local panels can be installed and checked out prior to installation of the data highway interface units.

The dual redundant Data Highway shall use electrical or optical transmission methods. The redundant channels will be routed independently around the plant to minimize the probability of catastrophic failure due to a single accident.

The DCS Operational Block Diagram shows the off-line activities connected to the off-line "host" computer using an off line data highway. This arrangement balances the computing loads between the processors but more importantly emphasizes the importance of separating off-line activities from the on-line control.

Training and software development facilities shall be equipped with an operator console, a DPU and an assortment of I/O cards. Two programmer stations consisting of a terminal and printer shall be supplied for software development. These facilities are separated by a folding door so that the training or development functions can be doubled if necessary by redeploying the equipment. All these activities will be preempted in the event that the back up processor must assume on-line duties.

The training console shall be provided with the same display and report software as any of the control room consoles and have access to simulated or on-line data. In addition to the use of real data, a method is required for the trainer to be able to induce specified "emergency" conditions onto the training console.

All commands originating from the training console and software stations must be intercepted rather than affecting the process unless specifically authorized by the supervisor.

Selection criteria will emphasize meeting performance specifications using standard system components rather than the use of a particular architecture.

2.2.2 Field I/O

Field I/O count is listed in Attachment B.

The allocation of the Field I/O to individual Field Operating Stations (FOS) and to Distributed Processing Units (DPU) within the FOS's will be displayed in Attachment C. These allocations will be made during detail design after the I/O count has been verified and the location of the FOSs and plant units has been decided.

2.2.3 Operator Consoles

The operator consoles are listed in Attachment D.

The portable terminals are for start up or maintenance activities. When used in this manner they are plugged either directly into the DPU for controlling a plant unit being started up or maintained or directly into the data highway when more than one DPU controls the plant unit.

Six portable terminals shall be provided one for each of FOS 3 - 8.

2.2.4 Local Control Panels

Local Control Panels which interface with the DCS are listed in Attachment IV.

All of these local panels will be based on microprocessors or Programmable Controllers which can communicate with the DCS.

The range of types of programmable controller and the associated communications methods will be identified during detailed design.

2.3 **SOFTWARE**

2.3.1 General Description

It is the intention that, in so far as possible, all the software and firmware used in the DCS will be mature, standard commercial offering available "off the shelf". The basic design shall utilize a distributed data base concept and be modular in nature, making it relatively easy to enhance and upgrade. Wherever possible, the logic for repetitive functions, such as data communications protocol, shall be in firmware rather than software.

The Distributed Control System is the primary means of monitoring and controlling the process and is the source of data for process development studies and the Waste Form Qualification procedure. The major on-line tasks are:

A. Maintain communications with the Distributed Processing Units located around the plant.

B. Continuously scan the process instruments and local control panels to record process performance and status data.

C. Maintain control of process actuators.

D. Perform periodic and on-demand calculations on the data.

E. Report local and remote alarms and equipment status changes.

F. Monitor system performance and provide bumpless failover for dual redundant items.

G. Continuously refresh displays on operator terminals and consoles. Displays include graphical and alphanumeric presentations of current and historical process and event data by process unit by logical group and sequence of events.

H. Accept approved operator commands, data inputs and control parameters.

I. Prepare periodic and on-request printed reports.

J. Print facsimiles of graphic screens on request.

K. Maintain an historical process data record.

L. Maintain event and alarm logs.

M. Maintain system security.

N. Maintain a log of the system, equipment and instrument status.

O. Prepare periodic data reports for transmission to the MIS.

To accommodate changes, each of the on-line software tasks listed above shall be table driven. The exact software configuration and specific data values used to monitor and control the plant shall be contained in tables which can be reconfigured or changed by a non-programmer.

The programs used to change the software configuration or data may be run in an on-line or off-line mode. If they can be run while the system is on-line there shall be specific security procedures which prevent changes from becoming operational unless authorization is granted by the control room supervisor.

One of the requirements of the system is to minimize risk by making the maximum use of standard "off the shelf" software. The vendor shall identify the source of all software proposed for the system and identify the software by the following categories.

2.3.2 Systems Software

This software is not specific to HWVP or, necessarily, to the DCS vendor, it is specific to the computers used and supplied by the DCS vendor as completely standard software. Examples include operating systems, software debugging tools, run time analyzers and diagnostic routines.

2.3.3 Real Time Standard Application Software

This software is the standard vendor proprietary software which performs the plant monitoring and control functions. If on-line changes are permitted to the control scheme, the software used to make such changes is also included within this category.

2.3.4 HWVP Specific Real Time Application Software

A second class of application software is very specific to the requirements of HWVP. Examples are the advanced control algorithms, special control sequences and operator prompt routines. Some of these applications may be implemented using special software structures built up from standard application packages, others may require custom programming of real time application modules. The vendor shall categorize the risk associated with such custom software by identifying the degree to which it is based on previously implemented modules.

2.3.5 Support Software

This software supports the real time standard applications. Included are detailed hardware diagnostics, software languages and compilers, the off-line data base generators and on-line software configurators, communications packet builders, display and report generators.

2.4 COMMUNICATIONS

The DCS has a communications connection to the MIS. This connection shall utilize a Plant Local Area Network (PLAN) which is shared with the other computer systems within IMACS. The only traffic on this communication link is the transmission of current and historical process data from the DCS to the MIS. The baseload is made up of data for the Waste Form Qualification process consisting of all analog input and calculated point averages being sent to the MIS at 6 minute intervals. It is expected that other data will be added as raw data is collected for use in studies designed to improve plant operations after the plant is commissioned.

For sizing purposes, the data traffic sent to the MIS is assumed to consist of updating all analog and discrete inputs to the DCS every 4 minutes.

The DCS computer transmits data to the MIS computer. The DCS vendor is responsible for the provision of his end of the communication link using industry standard communications protocol. The MIS vendor in turn is to use the same protocol to receive the data.

The supervisor and operators of the DCS have access to all "official" data released by the other computer systems to the MIS using dedicated terminals. If any of this data needs to be transferred from the MIS to the DCS, the transfer will be performed

manually by entering the data from the MIS display into the DCS console.

Some instruments are required to provide data to both the HPCS and the DCS. This will be implemented by using multiple contacts on the instrument or shared analog signals. Thus there will be no need to make provision for transferring process data between the two systems.

There are a number of Local Control Panels scattered around the plant each dedicated to the control of a small section of the plant. The typical panel will contain either an embedded PLC or microprocessor to provide the primary control. Each of these panels shall be interfaced to the DCS Data Highway.

The DCS interfaces with two additional control systems.

A. The Master Pump Shutdown System

B. The Computer Automated Surveillance System

The physical interfaces to these two external systems shall be implemented as hard-wired contact inputs or outputs to appropriate DPUs of the DCS.

2.5 SPARE CAPACITY

The HWVP control system is expected to be in service for a minimum of 20 years. One of the primary purposes of the control computer system is to collect data on the operation of the plant. This data will be analyzed off-line to assist in the development and modelling of more advanced control strategies.

To provide for implementing these strategies the DCS, shall have, initially, an installed spare capacity of 25 %, this quantity is included in the total I/O count of Attachment B. The DCS shall be capable of further expansion by adding additional hardware. The minimum additional expansion shall include the ability to:

A. Increase the count of each type of I/O within each data acquisition processor by a further 25%.

B. Increase the number of data acquisition and operator interface processors on the data highway by 25%.

C. Increase the computing capacity within each processor to process this additional load and still meet the response times of Paragraph 2.7. These additional computations are equivalent to increasing the initial computation load of each processor by 50%.

D. Increase the data highway capacity by 50%.

2.6 PERFORMANCE

The minimum performance required of each subsystem and the system as a whole are detailed below.

The DCS shall be designed to respond to various inputs in a timely fashion. The maximum reaction times which shall be achievable when the system is fully loaded are as follows:

A. 1 second to initiate a control action in response to a change in input when the input and output are resident in the same DPU.

B. 2 seconds to initiate a control response to an input change when the input and outputs are connected to different DPUs.

C. 4 seconds between detection of an alarm in a DPU and its display on the operator console

D. 4 seconds between input of an operator action and the start of physical implementation at the DPU.

E. 3 seconds between an operator request for a new display or program and the appropriate screen display being useable.

F. 2 seconds maximum between successive refreshes of dynamic information displayed on an operators console.

Historical performance data is required for operational control, for maintenance, for identifying improved operating strategies and for archival records. They will include: analog values, calculated values, changes of state of discrete variables and time stamps. These records shall be available at the DPU, the operator console and the DCS host computer.

When the DCS is operating normally, the process data flows continuously from the DPUs to the operator consoles and host computers. The consoles and host computers will be as up to date as the DPUs. When part of the DCS fails, each level of the DCS shall buffer historical data. Part of the recovery procedure shall include the transfer of blocks of historical data to update the existing historical files throughout the DCS.

Transfers of historical data from the DCS host to the MIS will occur in batches at user selectable intervals. The minimum transfer interval shall be no greater than 1 minute.

For estimating the memory requirements for this historical storage, space shall be allowed for each point in each data acquisition scan

stored at the minimum interval of 1 second. The estimated maximum number of process data points at each DPU and operator console is 150% of the analog inputs and discrete inputs physically or logically assigned to that location. For the host computers, the number of historical points shall be estimated as 150% of the DCS analog inputs and 150% of the discrete DCS inputs.

To ensure that no losses occur in data transferred between the various levels of IMACS, a copy of all data prepared for transmission shall be maintained and be available upon demand for a period covering the immediate past. This time shall be the greater of:

A. Three times the estimate of the time required to identify, isolate and repair any DCS failure or:

B. 12 hours at the DPUs

C. 24 hours at the Operator consoles

D. 24 hours at the host computers

In addition, 100% of the historical data points, all alarms and operator actions shall be recorded for the last 30 days at the each operator consoles and in the host computers. This data shall be available upon demand as data trends or sequential records of alarms and operator actions. The maximum rate at which alarms are generated is equal to 100% of the total analog input count at each location per hour.

A hard copy of all alarms and operator inputs in chronological order shall be provided in the control rooms.

2.7 RELIABILITY, AVAILABILITY AND MAINTENANCE

The DCS is required to operate for 24 hours per day. It shall be available to perform real time control functions for a minimum of 99% of the time. All other functions and parts of the system which are not necessary for real-time control, shall be available for a minimum of 96% of the time. In addition, no single subsystem or component failure shall result in the unrecoverable loss of data.

Provisions shall be made for on-line duplication (redundant) of parts or subsystems so that these minimum availability and performance requirements are met.

First level maintenance is limited to the replacement of individual circuit boards or larger subsystems. To minimize the downtime, the system shall be designed so that, such replacement can be performed without switching off the power or taking the system off-line.

On-line tests and the on-line and off-line hardware and software used shall be provided (to identify and isolate faults). Description shall include step by step diagnostic procedures with estimates of the times required to detect, identify and restore the failed subsystem or component to the operational state.

The mean time between failures shall be documented and these values together with the times to repair provided above used to demonstrate that the desired availability shall be achieved.

For equipment in the system, documentation supporting the MTBFs and availabilities shall be based on verifiable historical field data. For custom equipment and for the system as a whole, the MTBF shall be calculated using the methods of Mil. Std. 217E.

2.8 APPLICATION DATA

Preparation of the initial data bases, the software configuration and operator displays and reports will be performed during detailed design by the engineer.

This transferred data is to be used to configure the DCS as built to the DCS application so that the Factory Acceptance Test can be run under a representative load.

2.9 SOFTWARE DEVELOPMENT AND QUALITY ASSURANCE

The custom software to be developed shall be closely integrated with the DCS standard software. Plans used to develop such software shall be subject to some or all of the provisions of ANSI/ANS 10.4, ANSI/ASME NQA-1, and NUREG 0856.

These standards require that software be developed and Quality Assurance Plans conform to IEE 730 and the other standards referenced in Paraqraph 1.3.1.

Plans for custom software development and quality assurance shall be submitted for approval. These plans are expected to include as much as possible of the vendors standard systems.

The plans shall make provision for formal and informal visits by the purchaser to check on work progress. The formal visits shall be scheduled to mark significant progress in the development schedule such as completion of the Software Requirements Specification, formal walk through of the module definitions and completion of verification and validation tests. The work shall be subject to configuration control at all times and a verifiable audit trail shall be documented and available for inspection.

2.10 FACTORY ACCEPTANCE TEST

The Factory Acceptance Test shall be conducted in two phases. The primary test is a complete check of the hardware, and software. Following the successful conclusion of these tests, a second test shall be made at the MIS vendor facility. This secondary check will validate the operations of the communications when the full IMACS systems are operational.

The application software configuration data (Attachment 6) shall be loaded onto the system prior to the Factory Acceptance Test. This data will be the official data used to verify the performance of the system.

Exact details of the Factory Acceptance Test shall be determined during detailed design. It shall include checks on the operation of the system, the system documentation and compliance with the hardware and software development and quality assurance plans. The performance tests, shall include end to end integrity tests for each field input and output, demonstrations of each type of control logic loop using an external simulator, stand alone operation of each of the standard and custom software applications, and a fully loaded run. During the Fully loaded demonstration of the DCS, compliance with the response times specified shall be verified.

A simulator shall be used to verify that the communications to the MIS are operating correctly.

The DCS host computer periodically transmits data to the MIS computer. The DCS vendor is responsible for the provision of his end of the communications link, using an industry standard communications protocol. The MIS vendor in turn is to receive the data using the same protocol. To check these communications, it is the intention to temporarily stage one of the host computers at the MIS vendor's facility. The purpose of this staging is to verify the operation of each of the communications links on a stand alone basis and when all are working together. The DCS vendor will be required to support this effort with at least one person at the MIS vendor site for the duration of the tests.

2.11 DOCUMENTATION

Full documentation is required for all hardware and software. The documentation shall be organized into four packages. They are :

A. Management or overview package

B. Operator package

C. Maintenance package

D. Programming package

E. Twenty copies of each package are required.

2.12 LABELING

2.12.1 Equipment Labeling

Each item of equipment of the DCS shall have a stamped or engraved stainless steel identification nameplate. It shall be permanently affixed to the equipment by means of screws or stainless steel wire.

The following information shall be inscribed on each nameplate:

Name
Serial No.
Model No.
Tag No.
P.O. No.
Equipment Sequence No.
Item No.

A. Equipment Sequence Numbers

Equipment numbers shall be assigned by the Contracting Officer for the purpose of locating equipment and providing initial wire lists for equipment. The equipment numbers are TBD in Detailed Design.

B. Tag Numbers

Tag numbers shall be assigned by the Contractor. Tag numbers represent a finer breakdown of equipment than equipment numbers. Several pieces of equipment with different tag numbers may have the same equipment number.

The tag numbers shall be composed as TBD in Detailed Design.

C. Cable Labeling

Each cable shall have a permanent plastic tag, attached at source and termination, for identification to support interconnection with the DCS. The cable tag numbers shall use "to/from" coding to each connection point.

2.13 PAINTING

The DCS equipment shall be coated with the manufacturer's standard shop coating. The front surface shall be smooth, of uniform texture, and shall be free of pinholes, sags, runs, skips, scratches, dents, orange peel, crazing, or other imperfections.

Panels shall not be buffed, polished, or waxed. The panel finish shall be carefully protected from damage during handling and shipment. In addition to the front surface, the top, bottom, sides and back of panels shall be finished. Provide two gallons of touch-up paint.

The Contractor shall submit available standard colors for selection by the Contracting Officer.

2.14 PACKAGING

The DCS equipment shall be packed and/or protected by the Contractor's standard packing materials to ensure protection from moisture, vibration and shock during shipment. Packaging shall be designed to facilitate receiving, inspection, repackaging and storage by the Contracting Officer prior to installation. Subsequent storage will be for up to six months at the jobsite. Each package shall be individually identified with the following information:

Contractor's name
Project Identification and Destination
Purchase Order Number
Specification Number
Contractor's Model and Serial Number
Description of Equipment
Equipment Number

Components which are shipped separately from the consoles shall be packed using their manufacturer's original packing materials whenever practical. Each package shall be identified with the above shipping information.

A packing list identifying all items contained in the package shall be securely affixed to each separate shipping container.

2.15 DELIVERY

After completion of the Factory Acceptance Test, delivery of the system shall be made in three phases. Initially one of the host computers shall be delivered to the communications integrator at a site to be determined. The second shipment comprises the Field wiring and Termination cabinets which shall be shipped to the Hanford site on a date (TBD in Detailed Design). The final shipment of the balance of the system is to be made to the Hanford site on a date (TBD in Detailed Design).

Packing shall be to the vendors usual standard and delivery made on trucks equipped with air suspension and other equipment designed for the safe movement of computer equipment.

PART 3 EXECUTION

3.1 PREPARATION

(Not used)

3.2 INSTALLATION APPLICATION AND/OR ERECTION

3.2.1 Installation

The hardware requirements provide for a design in which the termination racks and cabinets can be installed and the field wiring completed and checked prior to the installation of the electronics. This will minimize the exposure of the electronics to deleterious ambient conditions such as vibration and dust. Connection of the electronics to the field termination racks shall be made using prewired electrical harnesses or multicored cable. A thorough check of the hardware and software is included as part of the Factory Acceptance Test so that field checkout of the DCS hardware installation will be minimized. Once all the hardware is installed and the hardware checked,system checkout can be started. The DCS system, as delivered, will be an almost standard system, it can be checked out according to standard procedures. A vendor factory representative shall be on site and shall lead this phase of the installation. Once the standard system has been checked,the final installation activity is to bring up and test the communications link to the MIS. The factory representative shall be involved in this activity and responsible for the functioning of the DCS end of the communications.

3.2.2 Installation Inspection

To be determined in Detailed Design.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Acceptance Test

(To be determined)

3.4 ADJUSTMENTS

(To be determined or not used)

3.5 CLEANING

(To be determined or not used)

3.6 **PROTECTION**

(To be determined or not used)

3.7 **DEMONSTRATION**

3.7.1 Training and Programming

The programming capability is provided for future development. Programming terminals and printers, off-line DPU, an off-line operator console and a printer capable of reproducing graphical CRT screens shall be provided. To assist with development and testing,the programmers shall have free access to the on-line programs and data base. However, the programmers ability to modify on-line programs or data bases shall be completely inhibited unless specifically authorized by the supervising operator.

Training will be provided by a standard operators console, an operator console printer and a DPU equipped with I/O cards. The console shall be capable of simulating any of the on-line or back-up supervisory and operators consoles. A method shall be provided which permits the trainer to configure the training console to simulate any one of the on-line consoles and to permit the trainer to make process changes and induce specific alarm conditions on the displays of the training console.

END OF SECTION

ATTACHMENT A

VENDOR DATA AND DRAWING REQUIREMENTS
(To be Provided by UCAT)

ATTACHMENT B

FIELD INPUT/OUTPUT COUNTS

LOCATION	AI	AO	DI	DO
VITRIFICATION BUILDING	1080	140	740	420
SUPPORT BUILDING	0	0	210	0
FAN HOUSE	160	50	120	80
WHT/RLST	260	30	200	80
CANISTER BUILDING	250	30	200	80
SERVICE BUILDING	540	40	430	130
OPERATIONS CONTROL BUILDING	?	?	?	?
TOTALS	2290	290	1900	790

Note : These numbers include 25% installed spares.

ATTACHMENT C

DPU I/O ASSIGNMENTS

	LOCATION	DPU I. D.
FOS 1	Vitrification	TBD
FOS 2	Vitrification	TBD
FOS 3	Vitrification	TBD
FOS 4	Service	TBD
FOS 5	Canister Storage	TBD
FOS 6	Waste Holding Tank	TBD
FOS 7	Fan House	TBD
FOS 8	Switchgear/Generator	TBD
FOS 9	Operations Control	TBD

Note: DPUs and termination cabinets should be sized for an additional 25% uninstalled spares.

ATTACHMENT D

DCS OPERATOR CONSOLES

Central Control Room Supervisor

Central Control Room HVAC

Central Control Room Power and Utilities

Central Control Room Feed and Melter

Central Control Room Canister Handling

Backup Control Room Process

Backup Control Room Process

Portable Terminal 1

Portable Terminal 2

Portable Terminal 3

Portable Terminal 4

Portable Terminal 5

Portable Terminal 6

ATTACHMENT E

LOCAL CONTROL PANELS

These control panels are not part of the DCS procurement. They will be intelligent in that their design incorporates either a PLC or a PC. There is a requirement for the DCS to communicate with them to collect data, to pass permissives or both. The communications requirements of each panel will be identified during detail design. The type of hardware used in the panels will be made available when known.

FOS	I.D.	Description
	LP-120-001	Safety Related Panel A
	LP-120-002	Safety Related Panel B
	LP-130-001	Local Panel Pour Turntable
	LP-130-002	Local Panel Drain Turntable
	PP-130-001	Control Cabinet Upper Electrodes
	PP-130-002	Control Cabinet Lower Electrodes
	PP-130-003	Control Cabinet Dome Heater A
	PP-130-004	Control Cabinet Dome Heater B
	PP-130-005	Control Cabinet Dome Heater C
	PP-130-006	Control Cabinet Dome Heater D
	PP-130-007	Control Cabinet Drain Valve Heater
	PP-130-008	Control Cabinet Riser Pourspout Heater
	LP-16A-001	Canister Decontamination Local Panel
	TV-130-001	TV Camera Number 1
	TV-130-002	TV Camera Number 2
	LP-170-001	Canister Closure Station Local Panel
	LP-170-002	Welder Local Panel
	LP-170-003	Leak Check Local Panel
	LP-210-001	CMA Local Panel

LP-210-003	CDMC Local Panel
LP-230-001	CDC STS Turntable Local Panel
LP-230-002	CDC STS Transfer System Local Panel
LP-230-004	Canister Entry Transfer Car Local Panel
LP-230-006	MC CDC Canister Transfer Car Local Panel
LP-230-007	Exit Tunnel Turntable Local Panel
LP-410-001	Air Com Sequence Control Panel
LP-410-002A	Air Compressors CX-410-VA Local Panel
LP-410-002B	Air Compressors CS-410-001VB Local Panel
LP-410-002C	Air Compressors CS-410-001VC Local Panel
LP-410-002D	Air Compressors CS-410-001VD Local Panel
LP-410-002E	Air Compressors CS-410-001VE Local Panel
LP-410-002F	Air Compressors CS-410-001VF Local Panel
LP-410-003	Inst Air Dryer Local Panel
LP-430-001	Process Steam Generator GS-430-001V Local Panel
LP-530-001	Liquid Waste Local Panel
LP-540-004	Cold Chemical Area Control Local Panel
LP-580-002	Frit Conveying Local Panel
LP-630-002	Gas Sampling Local Panel
LP-630-003	Gas Sampling Hood Local Panel
LP-630-004V	Sample Rabbit Control System Master Control Panel

ATTACHMENT H

DETAILED I/O LIST

To be determined

ATTACHMENT F

CUSTOM SOFTWARE

The software listed below is the special software which shall be developed for the HWVP application. Two modules are required, the first is the on-line module which will perform the task in real time. The second module is run off-line and is used by an engineer in interactive mode to prepare the driver tables for the on-line modules.

Implementation of Logic Controllers (YICs)

Implementation of Operator Interactive Displays, Interlocks and Sequences

Special algorithms for Advanced Control Functions

Communication between DCS and PLC/PC based Local Panels.

Communication between the DCS and the MIS

Modify Alarm Servicing for Hierarchical Processing

ATTACHMENT G

APPLICATION SOFTWARE CONFIGURATION

The application specific data shall be loaded on to the system by the manufacturer and will be used for part of the Factory Acceptance Test.

Load and check the application data bases including: I/O, calculated variables, Local Panel scanned variables, alarms, historical and Grouped displays

Load and check Analog loop algorithms, discrete interlocks and permissive logic

Load and check Complex logic and operator interactive sequences

Load operator DCS interactive sequences

Prepare graphic displays and Reports

Design and Configure Training Software